FACTORS AFFECTING THE DISTRIBUTION OF THE LEPTODACTYLID FROG *GEOCRINIA LAEVIS* IN THE SOUTH-EAST OF SOUTH AUSTRALIA

by R. G. BECK*

Summary

BECK, R. G. (1975).—Factors affecting the distribution of the leptodactylid frog *Geocrinia laevis* in the south-east of South Australia. *Trans. R. Soc. S. Aust.* **99**(3), 143-147, 30 August, 1975.

Geocrinia laevis (Gunther), a species of leptodactylid frog previously recorded from Victoria and Tasmania, was first reported in South Australia in 1966. A survey has revealed that this new population is an extension of that known to exist in south-west Victoria. The frog is extremely rare in South Australia, occupying only a fraction of the potential habitat for which it shows preference. Some thoughts on this are tendered as a basis for further studies.

Introduction

The leptodactylid frog *Geocrinia laevis* (Gunther) has been described in detail by Littlejohn & Martin (1964). The specimens found in the south-east of South Australia have been up to 25 mm long, with dorsal skin dark grey and slightly warty, ventral skin smooth and paler grey. All had distinctive pink markings on the groin and thighs and some specimens showed this colour under the forearms as well.

Prior to 1966, *Geocrinia laevis* was known to exist in four disjunct populations in Australia: Tasmania, King Island, the Grampians, and the area in south-west Victoria from Dartmoor to Port Campbell (Fig. 1). With the discovery (Woodruff & Tyler 1968) of a specimen from Marsh's Swamp near Mt Burr, some 80 km west of Dartmoor, it was desirable to establish whether this was a fifth isolate or an extension of the Victorian population.

Methods

The study area comprises the following Hundreds in County Grey: Mt Muirhead, Mayurra, Riddoch, Hindmarsh, Grey, Young, Nangwarry, Mingbool, Blanche and Gambier, and the adjoining area east of the state border to the Glenelg River.

The survey was undertaken from 1968 to 1974, and most areas were visited in both summer and winter. In the early stages of the survey, field work was concentrated around Marsh's Swamp (Site 3, Fig. 1. Grid reference 353362, Australian Army Survey Map, Penola, 1:250,000 Sheet SJ/54-6). From here the survey extended to the north-west, following the general zone of influence of the Reedy Creek drainage system, and to the south-east along the Dismal Swamp complex to the Glenelg River. Most field work was carried out during the daylight, but night road surveys were conducted in likely areas, yielding one specimen only.

When six specimens had been found, detailed botanical surveys were made of the surrounding areas, particularly of the nearest probable breeding site. Following the establishment of definite ecological patterns, soil surveys of these areas were undertaken.

Typical habitats

Geocrinia laevis normally lays eggs in areas which later become flooded. Breeding sites may be the edges of permanent swamps, or non-permanent swampy areas, often situated to the east of sandy rises, ranging from a few to 200 m away. The soils of the rises are podsolised sands, usually Mt Burr sands as described by Stephens *et al.* (1941). The swamps occur in Wandillo sands, and there may be several intermediate soil types between the rises and the swamps. For this reason, the natural dry sclerophyll forest may vary in type

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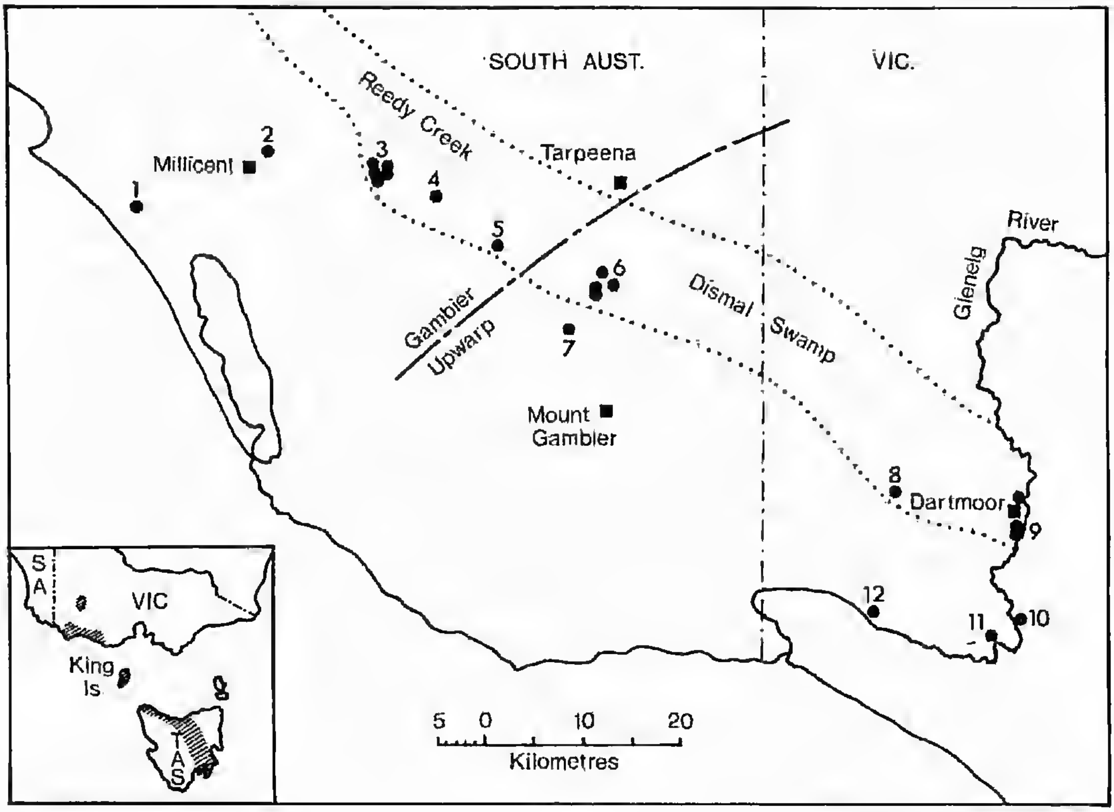

Fig. 1. Map of the lower south-east of South Australia and adjacent south-west Victoria, showing main collecting sites of *Geocrinia laevis* in relation to the Reedy Creek-Dismal Swamp Corridor. The inset shows known Australian distribution prior to 1966. (After Littlejohn & Martin 1964, 1965.)

and consist of any of *Eucalyptus baxteri*, *E. obliqua*, *E. huberiana* or *E. ovata* according to the soil type. However, the understorey in the vicinity of the swamps is remarkably constant, and four species have been found in all areas, *viz. Acacia melanoxylon, Leptospermum juniperinum, Melaleuca squarrosa* and *Helichrysum dendroides*.

The soil map of Stephens *et al.* (1941) plus the plant indicator species greatly facilitated later survey work and most potential areas in the south-east have now been examined.

Results

A total of 20 specimens of *G. laevis* have now been found in South Australia, and a further 10 in Victoria between the State border and the Glenelg River, which, prior to 1966, represented the known western limit of distribution. The species is common at Dartmoor, where on one occasion, 12 were found under a log in the bed of the Glenelg River. Details of the findings are given in Table 1. Representative specimens have been lodged with the S.A. Museum.

Of particular interest is the specimen collected at Grid ref. 376346 (site 7, Fig. 1), in a deep pit dug to observe pine tree root growth at the Forest Research Station north of Mt Gambier. This site is two km from the nearest potential breeding area, giving an indication of the actual mobility of the species, which is regarded as sluggish compared with other local species.

The distribution is shown in Fig. 1, and with one exception corresponds with normal dispersals from the Reedy Creek and Dismal Swamp complexes. It is suggested that the Canunda specimen (site 1, Fig. 1) is from a community established from eggs or larvae washed down one of the many man-made drains which cross the area between the Millicent Hills and the coast.

TABLE 1

Recorded distribution of Geocrinia laevis *in south-east South Australia and nearby Victoria*

Refer A.A.S. Map, Penola, 1:250,000, Sheet SJ/54-6

Grid Reference	Site No. (Fig. 1)	No. of Specimens	Collector	Remarks
353362	3	1	H. Minchan & C. Taylor	First S. Aust. specimen, SAM, R8118
353362	3	1	D. Woodruff	Melbourne University Zoology Dept. 220/67
353362	3	6	R. Beck	All within 2 km of original site at Marsh's Swamp
353362	3	3	D. Klem	Marsh's Swamp. One specimen, SAM, R10583
354364	3	1	F. Aslin	2 km NE of original site at Marsh's Swamp
381351	6	1	C. Taylor	Earl's, 16 km N of Mt Gambier
381353	6	1	R. Beck	Hein's scrub, 17 km N of Mt Gambier
378351	6	1	F. Aslin	Telford's scrub
378349	6	1	D. Klem	2 km S of Telford's scrub
376346	7	1	D. Klem	Forest Research Station, Soil Pit, SAM, R13974
368355	5	1	D. Klem	Hogarth's scrub
326360	1	1	J. Aslin	Canunda Reserve, SAM R13975
342366	2	1	F. Aslin	Night Road Survey, 5 km NE of Millicent
361361	4	1	A. Rowley	Lake Leake, SAM, R14199
Refer A.A.S. Map, Hamilton, 1:250,000, Sheet SJ/54-7				
414325	8	6	P. Roach	16 km E of State Border on Highway No. 1, SAM, R10780
414325	8	1	R. Beck	Same locality
427324	9	Many	R. Beck	Common in Glenelg River 2 km up and downstream from Dartmoor
Refer A.A.S. Map, Portland, 1:250,000, Sheet SJ/54-11				
428311	10	1	F. Aslin	East of Glenelg River near Jones' Lookout
409313	12	2	F. Aslin	Lower Glenelg River
424310	11	2	J. Aslin	Lower Glenelg River

The major geological and physiographic features of the region have been described by Sprigg (1952). The Reedy Creek and Dismal Swamp complexes are separated geologically by the Gambier Upwarp, and flow in wet years to the north-west and south-east respectively. However, the watershed gradient is so gradual, being only a few cm per km, that in extremely wet years such as 1896 and 1946 there was an almost continuously wet corridor from the Kingston district to the Glenelg River. Even in years of normal rainfall, swamps are close enough to provide ready access for frogs to the lower south-east from the Glenelg River.

The last occasion on which the Dismal Swamp actually flowed was in 1946, emptying into the Glenelg River just north and south of Dartmoor by way of the Scott and Ardno Creeks..

In the study area, *G. laevis* is restricted to areas receiving an average annual rainfall of 700 mm or more, whereas in Tasmania and Victoria it is found where rainfall is greater than 500 mm (Martin 1967). If the species in South Australia followed the Victorian rainfall pattern, it would be reasonable to expect the distribution to extend laterally about 100 km. Likewise, if it occupied all sites considered suitable on the basis of soil and vegetation patterns, an extended distribution pattern could be expected to the extent of about 50 km.

Discussion

Three facts emerge from the survey:

1. While it is certain that more specimens will be discovered within and beyond the present known range of distribution, *G. laevis* is extremely rare in south-east South Australia. Even at Marsh's Swamp, where most specimens have been found, I have not positively identified its calls during the April-May-June breeding season, when calls are commonly heard at Dartmoor, Victoria. However, Woodruff & Tyler (1968) have reported the recording of a mating call at Marsh's Swamp.
2. According to present known records, the species occupies only a fraction of the potential habitat for which it shows preference with respect to soils, vegetation and rainfall.
3. *G. laevis* was always found under the shelter of logs, litter, or stones during the day. As a result, the species has not been found in areas cleared for agriculture or pasture production.

Some suggestions for the reason for this restricted distribution are tendered as a basis for further work by someone with more time and resources than the present author. Rainfall and associated weather patterns are probably the major factors influencing the spread of any frog species. In 1967, an extreme drought was experienced in the lower south-east of South Australia. The average annual rainfall at Mt Gambier is 776 mm, but in that year only 402 mm fell, and unofficial figures from the Dismal Swamp area were as low as 280 and 330 mm respectively. In this single dry year, many of the local swamps previously considered permanent, dried up completely, and most of the non-permanent swamps stayed dry throughout the winter. As a result, none of the spring breeders bred, and only a few of the autumn and winter breeders actually spawned.

Since Crocker & Wood (1947) first presented evidence for a recent arid period, many workers have commented, and they are about equally divided in their acceptance or rejection of the concept (Mulvaney & Golson 1971; Littlejohn 1967).

Gentilli (1961) had already offered an explanation for this diversity of opinion: "Australia is a large land, spanning several major climatic belts, and may have experienced different climatic changes in various parts of the continent at the same time." This is supported, on a one year basis at least, by an examination of the Commonwealth Bureau of Meteorology rainfall figures from major Australian mainland centres for 1967. Perth, Broome, Darwin, Cairns, Brisbane and Sydney had greater than average rainfall, Geraldton and Alice Springs were only slightly lower than average, whereas Adelaide and Melbourne received approximately half their average amount. The coastal strip from the head of the Great Australian Bight to east of Melbourne obviously was the worst affected area.

Churchill (1968) has shown that, in Western Australia, during the past 5000 years there have been several fluctuations in climate of sufficient magnitude to cause the replacement of jarrah forests with karri and *vice versa*. Similarly, recent work by Dodson (1974) in the study area indicates variations in climate, with relatively dry periods between 5000 and 2000 B.P., and again since 1300 B.P.

Gentilli (1972) also supports the concept of changing climate. "It must be stressed that climate, being the result of numerous variables variously combined in space and time, can vary, fluctuate, oscillate, or just change." It follows that changes such as these must produce equally dramatic changes in the local fauna.

With pluvial conditions prevailing in southern Australia during the last glacial period, Bassian species extended their range (Littlejohn 1967) and it is reasonable to expect that *G. laevis* occupied much of the lower south-east of South Australia. With the return of present-day weather conditions, its range would have decreased but not to the limits found today. It is therefore suggested that in the recent past, possibly much more recently than that postulated by Crocker & Wood (1947), there has been a period sufficiently arid to cause the withdrawal of *G. laevis* and perhaps some other anuran species to the more favoured parts of south-west Victoria or even the Grampians. It must be emphasised that in this context the term "arid" is relative rather than absolute.

Reoccupation of the south-east of South Australia by *G. laevis* would have occurred by way of the Glenelg River and the Dismal Swamp when wetter conditions returned. This may have taken place even as recently as within historic times.

Since the settlement of the south-east of South Australia by white man, the area reached its physically wettest state in 1896. This information was obtained from S.E. Drainage Board records and also, some years ago, from old residents who remembered the district during the nineties. They claimed "you could row a boat across country from Kingston to the Glenelg River". While this is no doubt a slight exaggeration, it is surely significant to the distribution of frogs.

Colville & Holmes (1972) attribute the increase of wetness during the second half of the nineteenth century to the clearing of natural scrub. Subsequent widespread planting of pines and establishment of drainage schemes have greatly reduced surface waters.

Very recent reoccupation of the south east by *G. laevis* as outlined above would account for the limited spread of the species. Further distribution has been prevented by a combination of clearing the natural habitat, and the drying out of the district by drainage, pine plantations and the establishment of better pastures. It is obvious that much more study is required to explain satisfactorily this limited distribution.

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